CNTT-E-113

BASIC ELECTRICITY AND ELECTRONICS

STUDENT HANDOUT NO. 206

SUMMARIES PROGRESS CHECKS FOR MODULES

22 LESSONS 1,2,&3

JUNE 1984

SUMMARY

LESSON I

MODULE TWENTY TWO OSCILLATORS

Functional Analysis - Basic Oscillators

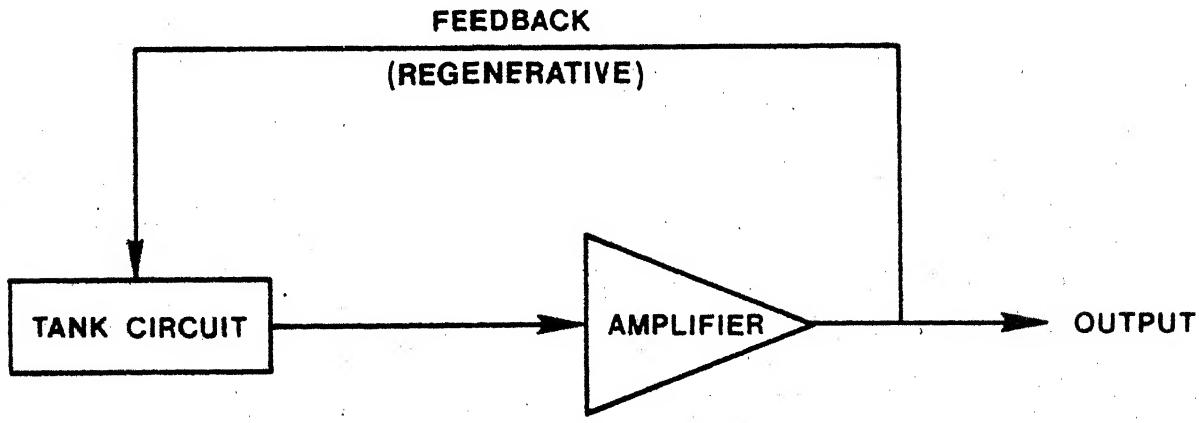
Oscillators must be considered in some detail in the study of electronics, since most electronic equipments employ them.

An oscillator is a non-rotating device for producing alternating current from a direct current supply, at a frequency determined by the characteristics of the device.

Alternators and generators (rotating devices) can produce AC at a variety of frequencies, but they are not classified as oscillators.

Electronic oscillators may not always produce sinewave AC, but only those that do will be considered in this module.

The figure illustrated below shows diagram for the basic oscillator:



The functions of the circuits are:

Tank Circuit: Develops the desired AC frequency.

Amplifier Section: Amplifies the tank circuit output to a usable level and compensates for energy losses in the components of the oscillator.

Feedback Loop : Returns part of the oscillator signal back into the tank circuit to insure that the tank circuit will continue to oscillate.

The output of the basic oscillator circuit is a sinewave at a constant amplitude and frequency.

AT THIS POINT, YOU MAY TAKE THE LESSON PROGRESS CHECK. IF YOU ANSWER ALL SELF-TEST ITEMS CORRECTLY, PROCEED TO THE NEXT LESSON. IF YOU FEEL THAT YOU HAVE FAILED TO UNDERSTAND ALL, OR MOST, OF THE LESSON, SELECT AND USE ANOTHER WRITTEN MEDIUM OF INSTRUCTION, AUDIO/VISUAL MATERIALS (IF APPLICABLE), OR CONSULTATION WITH YOUR LEARNING CENTER INSTRUCTOR, UNTIL YOU CAN ANSWER ALL SELF-TEST ITEMS ON THE PROGRESS CHECK CORRECTLY.

AUDIO-VISUAL RESPONSE SHEET
LESSON I

Functional Analysis Of Basic Oscillators

ANSWER ALL QUESTIONS FOR THIS STATIC/MOTION PROGRAM ON THIS RESPONSE SHEET.

1. What does an oscillator circuit do?

   a. Changes the AC input into a DC output.
   b. Produces a given frequency at constant amplitude.
   c. Changes the DC input into a higher amplitude D.C.
   d. Acts the same as a power supply.

2. Name three essential circuits of a basic oscillator.

   a. _____
   b. _____
   c. _____

3. Why is the tank called the heart of the oscillator?

   a. The tank converts AC to DC.
   b. The tank establishes the output waveform.
   c. The tank establishes the frequency of the oscillator.
   d. The tank determines the frequency of the input.

4. What is the function of the amplifier in the oscillator?

   a. The amplifier decreases the tank's output to prevent waveform distortion and provides energy for the feedback circuit.
   b. The amplifier increases the tank's output to a level sufficient for equipment operation and prevents energy from entering the feedback circuit.
   c. The amplifier decreases the tank's output to prevent waveform distortion and also prevents energy from entering the feedback circuit.
   d. The amplifier increases the tank's output to a level sufficient for equipment operation and provides energy for the feedback circuit.

5. What is the function of the feedback circuit?

   a. The feedback circuit maintains oscillations in the tank.
   b. The feedback circuit provides a means for changing the oscillator frequency.
   c. The feedback circuit amplifies the oscillator output.
   d. The feedback circuit feeds the oscillator output to the power supply.

PROGRESS CHECK
LESSON I

Functional Analysis

1. The function of a basic oscillator circuit is to

   a. convert AC to DC.
   b. convert DC to a desired AC frequency.
   c. supply the Audio Amplifier with the proper DC voltage levels.
   d. filter the DC variations from the power supply.

2. The tank circuit establishes the _____ of the basic oscillator circuit.

   a. voltage
   b. current
   c. frequency
   d. power

3. State the two functions of the amplifier in a basic oscillator circuit:

   a. _____

   b. _____

4. The feedback loop in a basic oscillator circuit will:

   a. sustain oscillations.
   b. feed energy back to the power supply.
   c. provide proper bias.
   d. establish oscillator frequency.

CHECK YOUR RESPONSES TO THIS PROGRESS CHECK WITH THE ANSWER SHEET. IF YOU ANSWER ALL SELF-TEST ITEMS CORRECTLY, PROCEED TO THE NEXT LESSON. IF YOU FEEL YOU HAVE FAILED TO UNDERSTAND ALL, OR MOST, OF THE LESSON, SELECT AND USE ANOTHER WRITTEN MEDIUM OF INSTRUCTION, AUDIO/VISUAL MATERIALS (IF APPLICABLE), OR CONSULTATION WITH YOUR LEARNING CENTER INSTRUCTOR, UNTIL YOU CAN ANSWER ALL SELF-TEST ITEMS ON THE PROGRESS CHECK CORRECTLY.

SUMMARY
LESSON II

Parallel Resonant Circuits

The tank circuit determines the frequency of the oscillator. Tank circuits store electrical energy in the electrostatic field of the capacitor and in the electromagnetic field of the inductor. Energy is transferred from capacitor to inductor and back again producing a sine wave output at a specific resonant frequency. This automatic energy transfer is called the flywheel effect.

If components were perfect, the flywheel effect would continue forever; however, because of internal losses of the components and wiring, the tank loses energy. This loss in energy lowers the amplitude of the sine wave until all energy of the tank is dissipated. This sine wave of decreasing amplitude is known as damped oscillations.

A fixed tank circuit has only one resonant frequency. The formula for the resonant frequency of the tank is $f_o = \frac{.159}{\sqrt{LC}}$. Therefore, the resonant frequency may be changed by adding inductors or capacitors to the tank. If capacitance or inductance is increased, the resonant frequency is decreased. They are indirectly proportional. Variable components are frequently used to change the resonant frequency over a range of frequencies.

In order to use a tank as a frequency producer, some method must be used to overcome the losses that cause damped oscillations. This method will be covered in Lesson IV.

AT THIS POINT, YOU MAY PROCEED TO THE JOB PROGRAM. IF YOU FEEL THAT YOU HAVE FAILED TO UNDERSTAND ALL, OR MOST, OF THIS LESSON, SELECT AND USE ANOTHER WRITTEN MEDIUM OF INSTRUCTION, AUDIO/VISUAL MATERIALS (IF APPLICABLE), OR CONSULTATION WITH YOUR LEARNING CENTER INSTRUCTOR, UNTIL YOU UNDERSTAND THE MATERIAL IN THIS LESSON.

AUDIO-VISUAL RESPONSE SHEET
LESSON II

Parallel Resonant Circuits

ANSWER ALL QUESTIONS ON STATIC/MOTION PROGRAM TWENTY TWO-II ON THIS RESPONSE SHEET.

1. Select the most correct definition of the flywheel effect.

   a. The reduced amplitude of the oscillations due to internal losses in the tank.
   b. The transfer of energy between the capacitor and inductor at resonance.
   c. The ratio of inductance to capacitance.
   d. The actions of a tank circuit with an AC input.

2. What causes damped oscillations?

   a. Changing frequency of the tank.
   b. The flywheel effect.
   c. Energy losses in the circuit.
   d. Improper input.

3. What would adding parallel inductance to a tank do to its frequency?

   ANS. _____ .

JOB PROGRAM FOR LESSON II

Damped Oscillations

INTRODUCTION

When working with oscillators the technician will find it necessary to be able to damp the undesirable portion of the output from an oscillator. In this job program you will assemble a tank circuit, cause it to oscillate and observe the damped waveform.

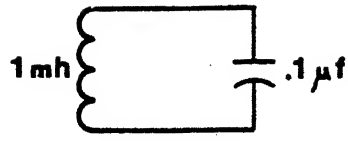
EQUIPMENT AND MATERIALS

1. Device 6F16
2. Template - C
3. Oscilloscope (6B28)
4. 1X Probe (2)

PROCEDURE

This oscillator (Template "C") is the one you will use for job program Twenty Two-IV. For this job program we will only need to use the tank circuit. (L1, C3).

Insert the 1 mh choke in L1.
Insert the .1 µf capacitor for C3



The CALIBRATOR OUTPUT of the oscilloscope can be used as a switch. It first puts out a positive voltage then switches to a negative voltage at a 1 KHz rate.

Using this signal to start oscillations we should be able to see the damped oscillations.

Oscilloscope Set Up

a. CALIBRATOR switch to 20 V
b. Channel 1 VOLTS/DIV to .1
c. TIME/DIV to 0.2 miliseconds/Div.

Connect a 1X probe to the CALIBRATOR OUTPUT JACK. (On the back of the oscilloscope.) Connect the probe tip to the top of the tank circuit (top of L1). Connect the probe ground clip to the bottom of the tank circuit (bottom of L1).

Connect a 1X probe to the Channel 1 INPUT jack. Connect the probe tip to the top of the tank circuit (top of C3).

Observe the waveform and note the damped oscillations each time the input signal switches.

De-energize 6F16, and replace all components in the component half of the 6F16 device. (Use pry-up tool to remove components). Return all equipment to its proper stowage.

IF YOU DO NOT SEE THE DAMPED WAVEFORM RECHECK YOUR SETTINGS AND PROCEDURES. IF YOU STILL HAVE A PROBLEM, SEE YOUR LEARNING CENTER INSTRUCTOR. YOU MAY NOW TAKE THE LESSON PROGRESS CHECK.

PROGRESS CHECK
LESSON II

Parallel Resonant Circuits

1. Identify the type of waveform generated by a tank circuit:

a. 

c. 

b. 

d. 

2. What is meant by the term damped oscillations?

_____

_____

3. If the value of capacitance is increased in a tank circuit, the resonant frequency will (increase/decrease).

4. If the value of inductance is increased in a tank circuit, the resonant frequency will (increase/decrease).

CHECK YOUR RESPONSES TO THIS PROGRESS CHECK WITH THE ANSWER SHEET. IF YOU ANSWER ALL SELF-TEST ITEMS CORRECTLY, PROCEED TO THE NEXT LESSON. IF YOU FEEL YOU HAVE FAILED TO UNDERSTAND ALL, OR MOST, OF THE LESSON, SELECT AND USE ANOTHER WRITTEN MEDIUM OF INSTRUCTION, AUDIO/VISUAL MATERIALS (IF APPLICABLE), OR CONSULTATION WITH YOUR LEARNING CENTER INSTRUCTOR, UNTIL YOU CAN ANSWER ALL SELF-TEST ITEMS ON THE PROGRESS CHECK CORRECTLY.

SUMMARY
LESSON III

Frequency Measurement With An Oscilloscope

To use an oscilloscope in order to measure frequency, you must be familiar with the terms "frequency", "cycle", and "period".

Frequency is the number of cycles for waveforms that occur in a specific unit of time.

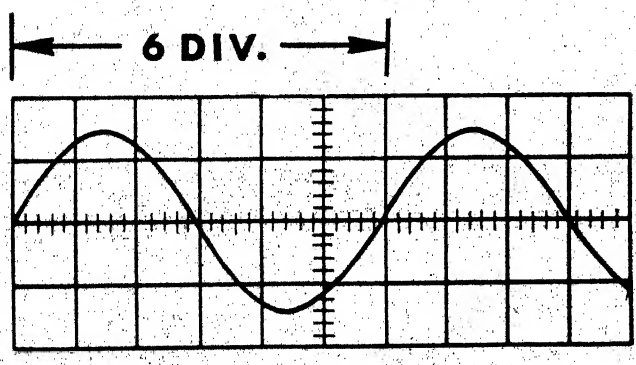
A cycle is a complete sequence of events. In our case, a repeating waveform that moves through one positive deflection, one negative deflection and returns to the point of origin.

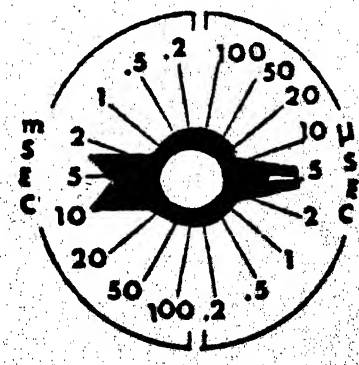
A period is the time required to complete one cycle of a waveform.

Once the period of a signal is measured, the equation $f = \frac{1}{t}$ may be used to evaluate the frequency.

Most oscilloscopes have a TIME/DIV CONTROL. This control allows you to vary the number of complete cycles displayed on the oscilloscope screen. To increase the accuracy of measurement, you should display the smallest number of complete cycles possible in one sweep.

To determine the period of a waveform, first count the number of centimeters of one complete cycle. Multiply this number of centimeters by the setting of the TIME/DIV CONTROL.





$t = 6\ cm \times 5\ \mu sec/div$

$t = 30\ \mu sec$

The period (t) is then inserted into the formula $f = \frac{1}{t}$.

$$f = \frac{1}{30\mu sec}$$

$f = 33.3$ KHz

Another control, TRIGGER LEVEL, can be used to move the starting point of the waveform in either a positive or negative position. The HORIZONTAL POSITION control moves the signal left or right with respect to the scope graticule. These will help you to more easily "read" the complete cycle.

AT THIS POINT, YOU MAY PROCEED TO THE JOB PROGRAM. IF YOU FEEL THAT YOU HAVE FAILED TO UNDERSTAND ALL, OR MOST, OF THIS LESSON, SELECT AND USE ANOTHER WRITTEN MEDIUM OF INSTRUCTION, AUDIO/VISUAL MATERIALS (IF APPLICABLE), OR CONSULTATION WITH YOUR LEARNING CENTER INSTRUCTOR, UNTIL YOU UNDERSTAND THE MATERIAL IN THIS LESSON.

JOB PROGRAM
FOR
LESSON III

Frequency Measurements Using An Oscilloscope

INTRODUCTION

You will find as technicians it is necessary to master frequency measurements using an oscilloscope. Many troubles in radar, radios, and other electronic equipment can be located using an oscilloscope to determine if the proper frequency is being generated.

EQUIPMENT AND MATERIALS

1. Oscilloscope (6B28)
2. Test Signal Box (connected to Exact Model 124 Multigenerator)
3. BNC-BNC coaxial cable.

PROCEDURE

1. Obtain a line trace.

2. Connect one end of the BNC-BNC coaxial cable to Channel 1 of the oscilloscope and the other end to Output #1 of the test signal box.

3. Adjust the TIME/DIV control to obtain the fewest complete cycles on the oscilloscope.

   TIME/DIV setting _____.

4. Move the TRIGGER LEVEL control in the negative direction (with AUTO/NORMAL Switch in Normal). What happens to the starting point of the waveform? _____.

NOTE: VOLTS/DIV AFFECTS TRIGGER SENSITIVITY.

5. Adjust the TRIGGER LEVEL control so that the length of one cycle of the waveform can be easily measured. Count the number of divisions that one complete cycle covers.

_____ Divisions.

NOTE: At times, it may be helpful to use the HORIZONTAL and/or VERTICAL positioning controls to more easily "sight" the dimensions of the waveform.

6. To obtain the period of the waveform, multiply the number of divisions by the setting of the TIME/DIV control.

_____ divisions X _____/division = _____.

7. Using the equation $F = \frac{1}{t}$, substitute the time of the period into the equation and carry out the indicated operations.

F = _____.

8. Disconnect the coaxial cable from output #1 and connect it to output #3 of the test signal box.

9. Obtain the fewest cycles on the oscilloscope.

TIME/DIV setting _____.

10. Calculate the period of one cycle.

period = _____.

11. What is the frequency of this waveform?

F = _____.

12. Connect the coaxial cable to output #5.
What is the frequency of this waveform?

F = _____.

CHECK YOUR RESPONSES TO THIS JOB PROGRAM WITH THE ANSWER SHEET. IF YOUR RESPONSES AGREE WITH THE ANSWER SHEET, YOU MAY TAKE THE LESSON PROGRESS CHECK. IF YOUR RESPONSES DO NOT AGREE OR IF YOU FEEL YOU HAVE FAILED TO UNDERSTAND ALL, OR MOST, OF THIS JOB PROGRAM, REVIEW THE PROCEDURES OF THIS JOB PROGRAM, ANOTHER WRITTEN MEDIUM OF INSTRUCTION, AUDIO/VISUAL MATERIALS OR CONSULTATION WITH YOUR LEARNING CENTER INSTRUCTOR UNTIL YOUR RESPONSES DO AGREE.

PROGRESS CHECK
LESSON III

Frequency Measurement Using An Oscilloscope

1. The complete sequence of events in a waveform is called a _____.

2. A _____ is the time required to complete one cycle.

3. A waveform's cycle can be measured from which points?

   a. trough to trough
   b. crest to crest
   c. leading edge to leading edge
   d. All of the above

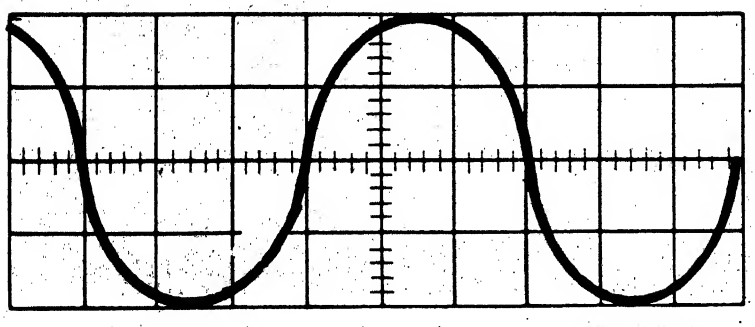
4. Calculate the frequency in the below examples.

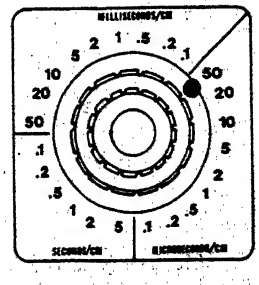
   a. Period = 50 msec _____ Hz
   b. Period = 200 µsec _____ Hz
   c. Period = 17.5 µsec _____ Hz

5. The _____ _____ _____ allows you to select the number of cycles displayed on the oscilloscope.

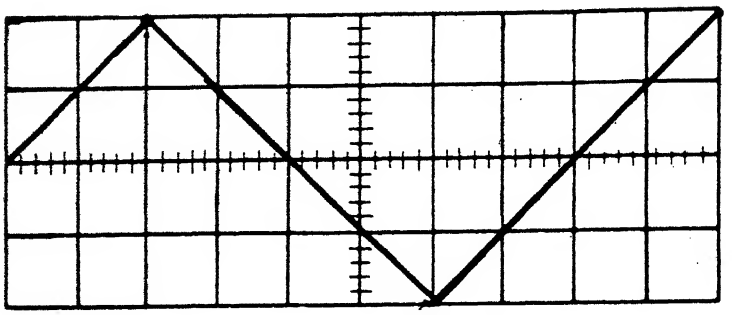
6. The _____ _____ _____ allows you to move the starting point in either a positive or negative direction.

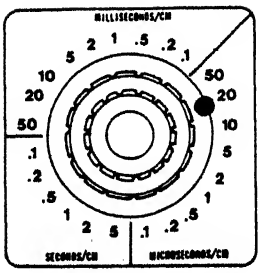
7. What is the frequency of the below waveform?





8. What is the frequency of this waveform?





F = _____ .

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ANSWER SHEET
FOR
PROGRESS CHECKS
LESSON I

Functional Analysis

QUESTION NO.	CORRECT ANSWER
1	b
2	c
3a	Amplify oscillations
3b	Compensate for energy lost in the tank
4	a

ANSWER SHEET
FOR
PROGRESS CHECKS
LESSON II
PARALLEL RESONANT CIRCUITS

QUESTION NO.	CORRECT ANSWER
1.	a
2.	Gradual loss of amplitude in that tank due to circuit losses
3.	Decrease
4.	Decrease

ANSWER SHEET
FOR
PROGRESS CHECKS
LESSON 11

Parallel Resonant Circuits

QUESTION NO.	CORRECT ANSWER
1	a
2	Gradual loss of amplitude in that tank due to circuit losses
3	Decrease
4	Decrease

ANSWER SHEET
FOR
JOB PROGRAM
LESSON III

Frequency Measurement with an Oscilloscope

3. .1 millisec/div

4. The starting point moves in a negative direction (or words to this effect.

5. 10 Div

6.

10 Div X .1 millisec/Div = 1 millisec

Period = 1 millisec = t

7.

$F = 1/t$

$$F = \frac{1}{1 \text{ millisec}}$$

$$F = \frac{1}{1X10^{-3}}$$

F = 1000 HZ or 1 KHZ

9. 20 or 50 μ sec/Div

10. period = 470 μsec

11. F = 2.1 KHZ

12. F = .70 KHZ

ANSWER SHEET FOR PROGRESS CHECKS LESSON III

QUESTION NO.	CORRECT ANSWER
1	Cycle
2	Period
3	d
4a	20Hz
4b	5000Hz or 5KHz
4c	57.14KHz
5	Sweeptime control
6	Trigger Level control
7	3.33KHz
8	6.25KHz